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Abstract This article reports a study of secondary students' perceptions of mathematics classroom learning environment and associations with their motivation to mathematics. A sample of 81 students (19 male and 62 female), in two schools were used. Students' perceptions of the classroom environment were assessed using a *What is Happening in This Classroom (WIHIC) Questionnaire.* An association of students' perceptions on the learning environment and motivation to mathematics was examined. The results of the t-tests for independent samples indicated a statistically significant difference in students' perceptions by school type. Simple and multiple regression analysis were used to examine the relationship between student motivation and perceptions. Simple correlation analysis showed that students' perceptions of some of the WIHIC scales are significantly associated to students' motivation. The results suggest that teachers wishing to improve students' motivation to mathematics should, in general, include lessons that allow for more of the positively perceived WIHIC measures.

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Introduction

The studies of classroom learning environments have been conducted, mainly in the developed world, for nearly four decades now. The many hours that students spend in the classrooms justifies the quest to understand what goes on in their *homes away from home* (the classrooms) environments. Interpretive studies using different learning environment instruments led Fraser, Fisher and McRobbie (1996, p. 2) to suggest that "there could be discrete and differently perceived learning environments within the same classroom." And so, it is important to assess and improve classroom environments (Fraser, 1989). Several studies have been conducted to predict students' outcomes from their perceptions of classroom psychosocial environment using various instruments (Fraser 1981; Fraser and Fisher 1982), involving cross-national studies (Aldridge, Fraser and Huang 1999; Aldridge, Fraser, Taylor and Chen 2000), including development and validation studies (Chionh and Fraser 1998; Fraser, Fisher and McRobbie 1996; Sinclair and Fraser 2001; Wong and Fraser 1995). Some other related studies have been conducted in different subjects in junior, middle and secondary schools (Fraser and Chionh 2000; Majeed, Fraser, and Aldridge 2001; Sinclair and Fraser 2001), studies at university level (Margianti and Fraser 2000; Yarrow, Millwater, and Fraser 1997), and science laboratory classes (Fraser, Giddings and McRobbie 1992). Several of these studies used environment instruments to compare students' perceptions of the actual and preferred classroom environments. Most of those studies have found that teacher and student perceptions of their classroom environment have a direct impact on their practices and interaction. Furthermore, the findings of these studies have often reproduced those of earlier research, which show correlation between the learning environment students' outcomes and for several scales.

In Ugandan schools, teachers talk about student academic achievement and behaviour when they are in the staff rooms or when engaged in informal discussions, but they rarely address the issues of classroom environment. But, in Australia, Fraser (1989, p.1) observed that "teachers often speak of classroom's climate, environment, atmosphere, tone, ethos or ambience," however, they rarely include these issues in their evaluation procedures.

Several studies have investigated students' perceptions of their classroom learning environments in different subjects such as Mathematics (Margianti, Fraser 2000) in a study conducted in Indonesia. Fraser (1989; 1998) attempted to inform science and mathematics teachers on how to assess and improve their classroom environment. Fraser, quite rightly, argued for a need to assess and improve classroom learning environment and he suggested a five-step procedure to do so that includes: (i) assessment, which requires establishing the state of the learning environment through students perceptions, (ii) feedback, that involves giving feed back on the picture of the classroom from the students perceptions, (iii) reflection and discussion, which involve the teacher's identifying deficiencies and giving a conscious effort and showing concern about them and discussing strategies for change with colleagues, (iv) intervention, that involves planning a course of action that attempts to change the classroom environment, and (v) reassessment, which involves establishing the consequences of the intervention. Indeed, Sinclair and Fraser's study (2001, p. 17) that confirmed that "teachers, who receive support and training, can use feedback based on a students' viewpoints to improve their classroom environments." Although the merger of qualitative and quantitative methods in classroom learning environment research has been advocated for and has been demonstrated (Aldridge, Fraser and Huang 1999; Fraser and Tobin 1991; Tobin and Fraser 1998), it was not applied in this exploratory study because the WIHIC instrument was not validated for Ugandan context. It was therefore felt that a later study should apply multiple methods.

As intimated earlier in this paper, previous learning environment studies have been mainly conducted in the developed world. But this study compared students' perceptions of the actual version of the classroom environment WIHIC instrument only because it was basically exploratory. As far as I can establish no known study has investigated students' perceptions in different types of schools, nor has any learning environment studies been done in Uganda. This is probably the first study of learning environment in the country. Indeed research has not fully addressed the question of classroom learning environment in Uganda. The country is therefore in dire need for such studies. This study hoped to, at least partly, fill this knowledge gap. The major purpose of this study therefore was: to investigate differences in the students' perceptions of their classroom environments by school-type; and to find out whether there are associations between students' perceptions of the mathematics classroom learning environment, as measured by the WIHIC scale, and their motivation to mathematics. In accordance with this purpose the following research questions were raised:

1. Are there differences in perceptions of learning environment between students in high performing and low performing schools?
2. Is there a relationship between students' perceptions of mathematics classrooms learning environment and motivation to mathematics?

Method

Design

This study followed a survey research design. This design was considered suitable because I was interested in the opinions of a large group of students about their opinions of their classroom environment as an issue of concern (Fraenkel and Wallen 1993).

Subjects

Data from two secondary schools out of the original nine schools that were used in a wider study were analysed for this paper. One of the schools was selected because it was observed to be high performing (HP) and the other was considered to be low performing (LP). The secondary schools in the country were ranked based on the mathematics average mark of the candidates in each school over the two years. The national average marks for the schools ranged from 2.4% to 57.4%. The schools were then divided into three groups: (1) schools with average in the bottom 27% of the range; (2) schools with average between 27% and 83% of the range; and (3) schools with average in the top 27% of the range. The 27% cut-off value was used to "provide the best compromise between two desirable but inconsistent aims: (1) to make the extreme groups as large as possible and (2) to make the extreme groups as different as possible" (Ebel 1979, p. 260). The schools in the bottom 27%-group were categorised as LP and the

schools in the top 27%-group were categorised as HP. The schools that were identified as either HP- or LP-school were located and requested to participate in the study. The sample consisted of 81 (19 males and 62 females) senior three (S3) students whose ages ranged from 14 to 20 years with a mean of 16.1 years. Both schools were located in the peri-urban areas and they were government aided schools (one single sex and the other coeducational).

Instrumentation

One instrument that was used in this study was a modified version of the *What is Happening in This Class?* Questionnaire (WIHIC; Fraser, McRobbie and Fisher 1996). The questionnaire contained statements that described what the class was like for the students about classroom practices that could take place in their classrooms. The students were asked to express their opinion and indicate how often each practice takes place by circling whether the statement occurs: Almost never, Seldom, Sometimes, Often or Almost always. The instrument was intended to capture students' perceptions of their classrooms. Only five of the original eight scales and eight items in each rather than the original ten items, which were deemed to be suitable in the Ugandan context, were used. The WIHIC was meant to measure five dimensions of the classroom environment namely: Teacher Support (TESU), intended to measure the "extent to which the teacher helps, befriends, trusts and shows interest in students"; Student Involvement (STIN), meant to measure the "extent to which students have attentive interest, participate in discussions, perform additional work and enjoy classes"; Task Orientation (TAOR), hoped to measure the "extent to which it is important to complete activities planned and to stay on the subject matter"; Cooperation (COOP), designed to measure the "extent to which students cooperate rather than compete with one another on learning tasks"; and Equity (EQTY), intended to measure the "extent to which students are treated equally by the teacher" (Aldridge, Fraser, and Huang, 1999, p. 50). There were eight items in each sub-scale giving a total of 40 items that used a five point Likert-type response format of Almost Never, Seldom, Sometimes, Often and Almost Always.

The internal consistencies of the WIHIC subscales, as shown by Cronbach-alpha reliability coefficients and the discriminant validity, which is the mean scale correlation of each scale with others, are shown in Table 1. In addition, to investigate the relationship between the students' perception of the classroom environment and their motivation to mathematics an 8-item scale, adapted from one sub-scale of the Fennema-Sherman attitudinal scales (Fennema and Sherman 1976) was included, as the final section on WIHIC questionnaire to assess students feelings about mathematics in terms of their motivation to mathematics. The motivation scale was intended "to measure *effectance* as applied to mathematics. The dimension ranges from lack of involvement in mathematics to active enjoyment and seeking of challenge." (Fennema and Sherman 1976 p. 326)

Procedure

The study was conducted as follows: The researcher delivered the WIHIC questionnaires to the head of mathematics department in each school. The head of department administered the WIHIC to the students in each school. Each school was assigned an identification code number, and each student was given an identification number (ID), as is the practice of assigning candidates index numbers for the national examinations in the country. The students involved who willingly accepted to participate in the study, filled their ID numbers rather than their names on their questionnaires. This was in support of research ethical considerations of anonymity and confidentiality (Mason 1996). The WIHIC administrators were directed to read and explain only the questionnaire instructions to the students. The administration of the questionnaire lasted for an average of 30 minutes. The administrators checked participant's questionnaire against the master role to ascertain that each student had correctly filled his or her ID. Finally, the administrators entered the school code number on each student's questionnaire after they were turned in. The researcher personally collected the completed questionnaires from each school for analysis.

Data Analysis

The questionnaire data collected were used to establish the instrument psychometric properties and to determine the internal consistency (reliability coefficient) of each scale. The differences between the perceptions of students in HP-schools and students from LP-schools were analysed using the two-tailed t-test for independent samples. To decide

whether associations exist between students' perceptions of the learning environment and students affective outcomes, simple correlation analysis and multiple regression analysis were employed.

Results

Psychometric properties of the instrument

The psychometric properties of any instruments include their reliability or internal consistency, the validity, the scale and composite means and standard deviations, the item-total correlations, the inter scale correlations and factor analysis of the instrument (Moely et al., 2002; Streiner and Norman 1995). In this study only the reliability, validity, scales' means and standard deviations are reported. The internal consistencies of the WIHIC subscales given by Cronbach-alpha reliability coefficients were computed using the Statistical Package for Social Sciences (SPSS) for Windows Version 13. Table 1 shows the internal consistency coefficient of reliability (Cronbach alpha) of each of the five scales' eight items for the individual as the unit of analysis. The scales reliability estimates ranged from 0.77 to 0.89. The mean correlations of a scale with other scales were used as an estimate of discriminant validity index that varied from 0.24 to 0.51. The analysis of the added eight item motivation scale showed internal consistency reliability (Cronbach alpha coefficient) for the individual students as, rather low 0.60 in the Ugandan context.

Table 1: Internal Consistency (Cronbach Alpha Coefficient) and Mean Correlation Coefficient of the Scales of the WIHIC

Scale	Sample Size	Alpha Reliability	Mean Correlation
Teacher Support (TESU)	80	0.85	0.24
Student Involvement (STIN)	81	0.88	0.51
Task Orientation (TAOR)	81	0.80	0.34
Cooperation (COOP)	81	0.77	0.41
Equity (EQTY)	81	0.89	0.43
Motivation (MOTV)	81	0.60	

Differences in students' perceptions of learning environment between students in HP- and LP-schools

To establish whether differences exist in the perceptions on WIHIC measures of students in the HP-schools and those in the LP-schools, t-test values for independent samples was computed. Table 2 indicates the means, standard deviations, and the t-test values for independent school samples that were used to examine whether differences in WIHIC scale scores between HP- and LP-schools were found to be statistically significant.

The results showed that the mean motivation for students in the HP-schools was 30.8 (SD = 5.57), and the mean for the students in the LP schools was 26.1 (SD = 4.02); $t(70.9) = 4.37$, $p < .05$, were significant. The results showed that there were three statistically significant differences ($p < 0.05$) between students in the HP and LP schools in the WIHIC measures (on TESU and STIN in favour of LP-schools and on COOP in favour of the HP-schools).

Table 2: Item Means, Standard Deviations and t-Test for Independent Samples for Students in different School Types (High-performing Schools and Low-performing Schools)

WIHIC Scale	No. of Items	Item Means		Item Standard Deviations		Differences Between Sex: t-values
		HP	LP	HP	LP	
Teacher Support	8	20.78	26.58	6.29	7.69	-3.69*
Student Involvement	8	23.73	28.22	6.57	7.57	-2.85*
Task Orientation	8	34.40	32.46	4.72	6.03	1.61
Cooperation	8	31.25	28.58	5.65	6.03	2.05*
Equity	8	31.23	32.02	7.75	6.91	-0.49
Motivation	8	30.80	26.07	5.57	4.02	4.37*

Note: WIHIC means What is Happening in This Class? Questionnaire
*p<.05. The sample consisted of 81 students in four classes in two schools.

Figure 1 shows a plot of changes in the mean scale WIHIC scores that disclose that students from HP-schools perceived the TAOR and COOP scales as occurring more frequently in their mathematics classes and those students in LP-schools perceived TASU and STIN scales as occurring more frequently. Both groups were rather ambivalent about the EQTY scale but with a marginal favour of students in the LP-schools. In sum, the mean scores in both types of school shows a consistent pattern of increase and fall in mean WIHIC scores across schools that were statistically significant for the TESU, STIN and COOP measures.

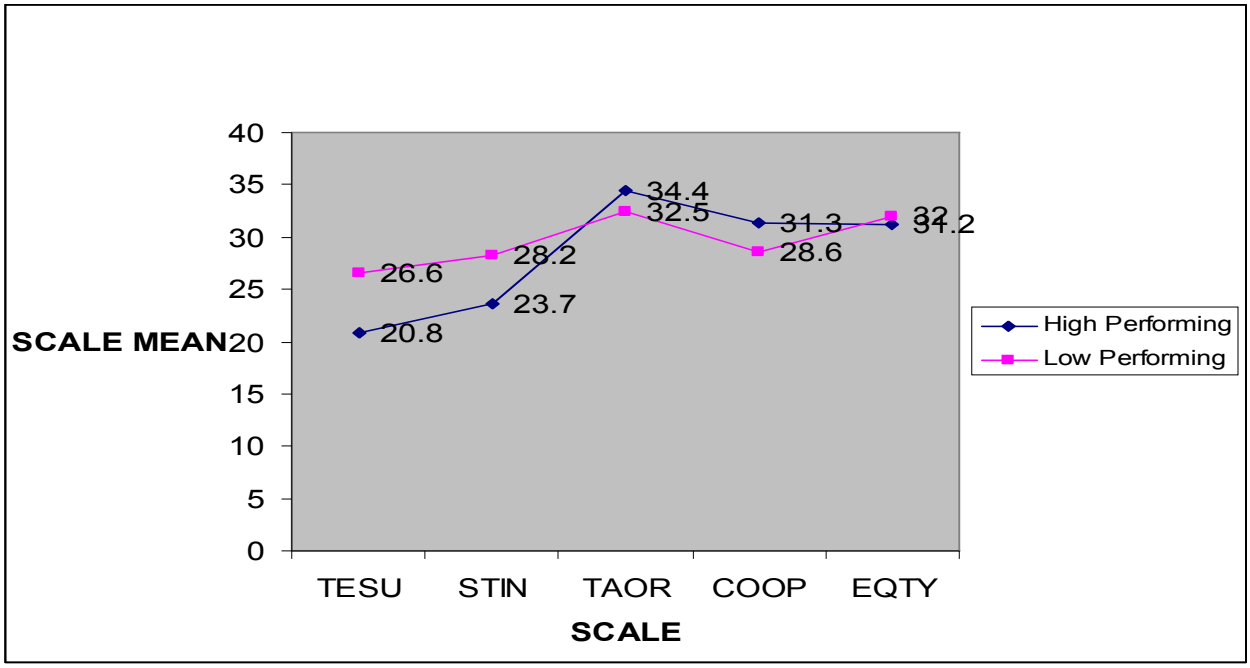

Figure 1: Comparison of students' perception on the WIHIC learning environment in high performing and low performing schools

Associations between students' perceptions of their mathematics classrooms and their motivation to mathematics

An examination of the simple correlation coefficients in Table 3 indicates that all the bivariate correlations between the WIHIC measures and motivation were positive. All the WIHIC measures were found to show statistically significant relationships (p <0.05) between students' perceptions of learning environment and their motivation to mathematics. The correlations between students' motivation and the WIHIC scales for the HP-schools ranged from 0.26 to 0.61 and for the LP-schools ranged from 0.21 to 0.51. It was only the COOP measure that was not statistically significant in the LP-schools. Students' perceptions showed a statistically significant correlation with their motivation to mathematics for all the scales in the HP-schools and for all the scales except the Cooperation in the LP-schools.

A multiple regression analysis was conducted to predict the association of students' motivation to mathematics from measures of the WIHIC scales. The predictor variables were the TESU, STIN, TAOR, COOP and EQTY measures. The criterion variable was the motivation to mathematics as a measure of involvement in mathematics and seeking challenge in mathematics. Table 3 shows the associations between the five WIHIC scales and students motivation to mathematics. A multiple regression analysis involving the whole set of the WIHIC scales was conducted to evaluate how well the WIHIC measures predicted the motivational level. The predictors were five WIHIC scales while the criterion variable was the level of motivation to mathematics. The linear combination of the WIHIC measures was significantly related to motivation $F(5, 74) = 7.31$, $p<.001$. The sample multiple correlation coefficient was R = 0.58, indicating that approximately 33% ($R^2 = 0.331$) of the variance of motivation in the sample can be accounted for by the linear combination of the learning environment measures. In addition, a simple and bivariate correlation analysis was conducted to provide a more comprehensive test of associations between each WIHIC scale and motivation to mathematics when other WIHIC scales were mutually controlled.

Multiple correlations were also statistically significant ($p<0.05$) for both types of schools. To identify which WIHIC scales contributed to variation in students' motivation, the standardised regression weights (β) were examined. The examination of the beta weights revealed that, sorted in descending as, STIN, COOP and TAOR were the strongest independent predictors of students' motivation to mathematics in the HP-schools. And in contrast, TESU, TAOR and STIN were the strongest independent predictors of students' motivation to mathematics in the LP-schools. The multiple regression results suggest that students were more motivated in classroom environments in which there was more STIN, COOP and TAOR in the HP-schools and students were more motivated in classroom environments in which there was more TESU, TAOR and STIN in the LP-schools. Apparently, TESU and COOP were negatively associated to motivation of students in the HP-schools and LP-schools respectively.

Table 3: Correlations between the five WIHIC scales and student motivation to mathematics

	High Performing		Low Performing	
Scale	**r**	**β**	**r**	**β**
Teacher Support	0.26*	-0.07	0.51**	0.36
Student Involvement	0.61**	0.34	0.39**	0.04
Task Orientation	0.52**	0.15	0.45**	0.35*
Cooperation	0.57**	0.25	0.21	-0.22
Equity	0.45**	0.16	0.36*	0.16
Multiple correlation, R	0.69**		0.61*	

* $p<0.05$; ** $p<0.01$

Discussion

This paper has described a study of relationships between students' perceptions of the classroom learning environment as measured by the WIHIC instrument and their motivation to mathematics. The study highlighted the importance of studies of the learning environment to help understand what happens in the mathematics classrooms. It also used multiple regressions to examine the association of students' motivation to mathematics from measures of the WIHIC scales. One key finding of this study was that in general there are differences in student perceptions of

their classroom learning environments by school type. That means that students in the HP-schools perceived their classroom environment differently from the perception of the students in the LP-schools in favour of students in the HP-schools. A comparison of the WIHIC scale mean scores between the students in the HP- and LP-schools showed that the students in the HP-schools perceived their classroom learning environment more favourably than the students in the LP-schools in the TAOR and COOP measures. This finding indicates that, students in HP-schools view task orientation and cooperation more positively in their classrooms. In contrast, students in the LP-schools perceived the learning environment more favourably than the students in the HP-schools in the TESU and STIN measures. This finding indicates that, students in LP-schools view teacher support and student involvement more positively in their classrooms. Students in both types of schools nearly equally perceived the EQTY measure. One possible explanation could be that the differences in the student perceptions results from or is attributed to the schools' culture and the type of teachers and administration in them. In the HP-schools, the culture seems to be that teachers provide students with challenges to extend student work; they also assign and give students plenty of work as exercises and tests. It appears that students are usually motivated by assessment in the form of homework, tests and examinations. Students are therefore constantly under pressure to perform. The students are also regularly challenged to provide and defend their solutions in writing and orally. This is not a common phenomenon in the LP-schools where the atmosphere is more les-affair. As a result students possibly acquire different motivation and perceptions of their classroom and school environment.

Another explanation could be that students could have differently defined and interpreted the classroom learning environment. Students could have applied a narrow definition of the learning environment, which is commonly taken to entail the availability of learning resources, instructional media and facilities such as text books as is commonly used. This finding replicates those of Aldridge and Fraser (1999), and Chionh and Fraser (1998) that reported associations between the learning environment and students' outcomes for most scales. The results suggest that teachers wishing to improve students' motivation to mathematics should, in general, include lessons that allow for more STIN and TAOR. It is therefore evident that teachers need be clear about their students' perceptions of their classroom environments differently in different types of schools to guarantee their building of acceptable outcomes.

Another finding was that when the relationships between students' motivation and classroom environment were investigated using simple regression analysis showed associations between motivation and learning environment to be statistically significant ($p<.05$). The differences in student perceptions among schools could be linked to the socio-economic background of the majority of the students in them. Students' motivation was found to be positively associated with all the WIHIC scales except the COOP scale in the LP-schools. The fact that COOP is not related to motivation appears unexpected and odd. This can be interpreted to mean that in spite of the fact that cooperative mode of teaching and learning is advocated for in most classrooms, through discussion and group work, some students do not perceive it as motivating. This result suggests that improved motivation is strongly associated with STIN and COOP in HP-schools and with TESU and TAOR in the LP-schools. Consequently, they suggest that teachers wishing to improve students' motivation to mathematics should, in general, include lessons that allow for more STIN and TAOR.

The multiple correlations in both the HP- and LP-schools are statistically significant ($p < 0.05$). The regression model shows that in the HP-schools, STIN, COOP and TAOR, in that order of strength, are the predictors of student Motivation. In contrast, in the LP-schools it is TESU, TAOR and STIN that are predictors of student Motivation. Apparently, TESU and COOP are negatively correlated to student Motivation in the HP- and LP-schools respectively. The students in the HP-schools appear to be self-driven and need minimal TESU to determine their motivation to mathematics. It would appear that the students in LP-schools need less cooperation because a few of them tended to be loners and did not work well in groups with others. This result reinforces Opolot-Okurut's (2004) call of the need by teachers to facilitate task orientation and motivation in their classrooms. He cited Kloosterman and Gorman as having suggested that to build task involvement and motivation in mathematics classrooms teachers need to communicate to students that they know they can learn mathematics; praise student effort and performance when deserved; employ cooperative grouping and encourage discussion of mathematics among students; when students go wrong in a problem, encourage them to try again and again rather than letting them to worry about their failure. The results suggest that teachers wishing to improve students' motivation to mathematics should consider their classroom environment, for it is quite feasible that all teachers can endeavour to improve the quality of effort they make in their own classrooms.

Conclusions

The results of this study are important in several ways. The findings lead to the following conclusions:

1. There are differences in student perceptions of their classroom learning environments by school type.
2. Students' motivation is positively and significantly associated with all the WIHIC scales except the COOP scale in the LP-schools.
3. The regression model shows that in the HP-schools, STIN, COOP and TAOR, in that order of strength, are the predictors of student Motivation.
4. The regression model shows that in the LP-schools it is TESU, TAOR and STIN that are predictors of student Motivation.
5. TESU and COOP are negatively correlated to student Motivation in the HP- and LP-schools respectively.

This study has broken new grounds in assessing classroom learning environment in mathematics classrooms in Ugandan schools and investigated the learning environment associations of one students' affective variable. Although the study has produced several worthwhile findings, several limitations can be cited that affect the generalisability of the results of the study. First, there may be a need to develop and validate a classroom learning environment instrument in the Ugandan context, which this study did not do but relied on existing instruments. Second, these results are non-generalisable and are limited to the small sample of schools and students used in the study. Third, the scope of the study only included motivation as a student outcome measure, but this could have been improved with consideration of other attitudinal and cognitive measures. Fourth, only quantitative data were used for this study and yet qualitative data could have enriched and provided additional information for triangulation. Finally, the reader is therefore advised to take a careful acceptance of the conclusions arising from this study.

Implications for teaching and learning

The results of this study have provided a vast justification for more concerted effort on investigating further the influence of classroom environment measures on students' learning outcomes that affect the teaching learning process. Consequently, some important implications and recommendations for future research arise from the findings of this study. First, mathematics teachers and curriculum developers need to recognise the role that the study of classroom learning environment might play in modelling teacher practices and improving the quality of the mathematics teaching and learning process. Second, other studies such as Yarrow, Millwater and Fraser (1997, p. 68) that suggest that "the field of classroom learning environment provides potentially valuable ideas to help teachers become more reflective and improve practice" and facilitate student teachers' engagement in action research. Action research, if implemented can enable teachers acquire knowledge to assess and improve classroom learning environment that could enhance students' learning outcomes. Third, the findings of this study have contributed to and support learning environment studies reinforce the need for the incorporation of learning environment studies into the education practices and research to investigate teachers' and students' perceptions of the same classrooms which have sometimes been found to be mismatched using both qualitative and quantitative research methods (Aldridge, Fraser and Huang 1999; Fraser and Tobin 1991). Fourth, this study supports the call and lead by scholars like Aldridge, Fraser and Huang (1999) and Sinclair and Fraser (2001) among others, for more research to be conducted to ascertain the relationship between classroom learning environment and student outcomes, conduct national and cross-cultural and cross-national comparative studies. Fifth, although reliance on the results from one-shot study like this one should be treated with caution, the indication of possible alterations of some measures in the classroom learning environment is significant for mathematics teaching everywhere but most in especially in the developing countries.

In summary, the findings of this classroom environment study have a number of interesting and important implications for both practice and further research. From a practical point of view, three implications are apparent from the findings. First, teachers should be made aware of the different aspects of their classroom environments. For example, the CLES instrument used in this study covered aspects of Teacher Support, Student Involvement, Task Orientation, Cooperation, and Equity in the classroom environment. Students perceived these aspects of their classroom environment differently in the two types of schools and probably between classrooms within the same school. But, in addition, there are some other aspects of the classroom learning environment that are covered in other classroom environment instruments worth knowing about. Second, teachers, especially those in the HP schools, in

light of the findings of this study must provide more teacher support and increase student involvement in their classrooms so as to improve the student motivation to learn mathematics to supplement cooperation that is practiced to promote learning. Third, in general, teachers need to pay more attention and study and change their classroom learning environment towards positive perceptions of the students.

In terms of further research the following areas are suggested as needing more research. (1) Associations between classroom environment aspects and other affective variables should be examined. (2) The study could be replicated to a larger sample of students and also at different levels of the education system. (3) The possible prediction of students' outcomes from their perceptions of the classroom learning environment should be investigated. (4) The factors that are causes or associated with the student perceptions of the classroom environment should be scrutinised. (5) A classroom environment instrument for Uganda should be developed, validated and used. (6) A research approach that combines quantitative and qualitative research methods is necessary to triangulate these findings that were mainly quantitative.

References

Aldridge, J. M., Fraser, B. J., & Huang, T. I. (1999). Investigating classroom environments in Taiwan and Australia with multiple research methods. *Journal of Educational Research, 93(1),* 48 – 62.

Aldridge, J. M., Fraser, B. J., Taylor, P. C., & Chen C. (2000). Constructivist learning environments in a cross-national study in Taiwan and Australia. *Int. J. Sci. Educ., 22(1),* 37-55.

Chionh, Y. H., & Fraser, B. J. (1998). *Validation and use of the 'What is Happening in This Class? (WIHIC) questionnaire in Singapore.* Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA.

Ebel, R., L. (1979). *Essentials of educational management (3rd ed.).* Englewood Cliffs, NJ: Prentice-Hall.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitude toward mathematics by females and males. *Journal of Research in Mathematics Education, 7*, 324-326.

Frankel, J. R., & Wallen, N. E. (1993). *How to design and evaluate research in education, (2nd edn.).* New York: McGraw-Hill, Inc.

Fraser, B. J. (1981). *Test of Science-Related Attitudes (TOSRA).* Melbourne, Australia: Australian Council for Educational Research.

Fraser, B. J. (1989). Assessing and improving classroom environment. *What Research Says to the Science and Mathematics Teacher, No.2.* National Key Centre for School Science and Mathematics, Curtin University of Technology: Perth, Western Australia.

Fraser, B. J. (1998). Science learning environment: Assessment, effects, and determinants. In B.J. Fraser, & K.G. Tobin (Eds.), *International Handbook of Science Education,* (pp. 527-564). Dordrecht, The Netherlands: Kluwer.

Fraser, B. J.,Giddings, G. J., & McRobbie, C. J. (1992). Assessing the climate of science laboratory classes. *What Research Says to the Science and Mathematics Teacher, No.8.* National Key Centre for School Science and Mathematics, Curtin University of Technology: Perth, Western Australia.

Fraser, B. J., & Fisher, D. L. (1982). Predicting students' outcomes from their perceptions of classroom psychosocial environments. *American Educational Research Journal, 19,* 498-518.

Fraser, B. J., McRobbie, C. J., & Fisher, D. L. (1996, April). *Development, validation and use of personal and class forms of a new classroom environment instrument.* Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.

Fraser, B. J., & Tobin, K. (1991). Combining qualitative and quantitative methods in classroom environment research. In B. J. Fraser and H. J. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 271-292). Oxford: Pergamon.

Majeed, A., Fraser, B. J., & Aldridge, J. M. (2001). *Learning environment and student satisfaction among junior secondary mathematics students in Brunei Darussalam*. Paper Presented at the Annual Meeting of the American Educational Research Association (AERA), Seattle, WA., April, 10-14, 2001, 1-27.

Margianti, E. S. & Fraser, B. J. (2000). *Learning environment, mathematical ability and students, outcomes in university computing courses in Indonesia*. Paper presented at the Second international conference on Science, Mathematics and Technology Education, Taiwan.

Mason, J. (1996). *Qualitative researching.* London: Sage.

Moely, B.E., Mercer, S.H., Ilustre, V., Miron. D., & McFarland, M. (2002). Psychometric properties and correlates of the Civic Attitudes and Skills Questionnaire (CASQ): A measure of students' attitudes related to service-learning. *Michigan Journal of Community Service learning, Spring, 2002,* 1-11.

Opolot-Okurut, C. (2004). Attitudes towards mathematics, achievement in mathematics aptitude problems and concomitant teacher practices in Ugandan secondary schools. Unpublished Ph.D. Thesis, University of the Western Cape.

Sinclair, B.B., & Fraser, B.J. (2001). *Changing classroom environments in urban middle schools*. Paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA., April 2001, 1-22.

Streiner, D.L., & Norman, G.R. (1995). *Health measurement scales (2nd edn.).* Oxford: Oxford University Press.

Tobin, K., & Fraser, B.J. (1998). Qualitative and quantitative landscapes of classroom environments. In B.J. Fraser and K.G. Tobin (Eds.), *International Journal of Science Education,* (pp. 632-640). Dordrecht, The Netherlands: Kluwer.

Wong, A. F. L., & Fraser, B. J. (1995). Cross-validation in Singapore of the Science Laboratory Environment Inventory, *Psychological Reports, 76,* 907-911.

Yarrow, A., Millwater, J., & Fraser, B.J. (1997). Improving university and primary school classroom environments through pre-service teachers' action research. *International Journal of Practical Experience in Professional education, 1(1),* 68-93.